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No. 54

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USSR REPORT

PHYSICS AND MATHEMATICS

No. 54

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USSR UDC: 533.6.013.42

NUMERICAL SOLUTION OF THE PROBLEM OF THE HYDROELASTIC OPENING OF A SHELL IN A FLUID FLOW

Kiev DOPOVIDI AKADEMIYI NAUK UKRAYINS'KOYI RSR, SERIYA A, FIZYKO-MATEMATYCHNI TA TEKHNICHNI NAUKY in Ukrainian No 4, 1979 p 278-283 manuscript received 25 Jul 78

SELEZOV, I. T., YELISYEYEV, A. M., KUCHUHURA, A. K. and TSYHANOV, M. K., Institute of Hydromechanics, UkrSSR Academy of Sciences

[Abstract] This is a continuation of an earlier study (I. T. Selezov et al DOKL. AN USSR, Ser. A, No 8, 1978, pp 751-756) which stated a new class ofproblems concerning aerohydroelastic opening of a shell as an element of a braking system in a flow of fluid or gas. Now a numerical solution of the problem of the opening of an elastic shell of revolution (a dome) by the flow incident on it is presented within the framework of a mathematical model of a potential stall-free flow of an inviscid incompressible fluid around a dome, by analogy with the opening of a parachuse. The dome in the course of its opening is approximated by a k-symmetric then uniaxial uniformly permeable shell. The problem is formulated as an initial boundary-value problem for the system of equations of the hydrodynamics and dynamics of an elastic soft shell. A numerical algorithm for the solution of the problem is presented. Findings on the numerical solution of the associated problem of hydorelasticity are given as well as compared with the known experimental data and found to be in agreement with those. Figures 2; references 11: 9 Russian, 2 Western.

USSR UDC: 539.3

THERMOELASTIC SURFACE WAVES IN A REGULARLY STRATIFIED HALF-SPACE

Kiev DOPOVIDI AKADEMIYI NAUK UKRAYINS'KOYI SSR, Seriya A, FIZYKO-MATEMATYCHNI TA TEKHNICHNI NAUKY in No 4, 1979 pp 287-290 manuscript submitted 23 Jun 78

SHUL'HA, M. O., Institute of Mechanics, UkrSSR Academy of Sciences

[Abstract] The propagation of thermoelastic waves in a regularly stratified isotropic medium formed by the regular alternation of layers displaying different thermomechanical properties is investigated with the object of deriving an exact solution of the three-dimensional problem of connected thermoelasticity. Methods of the theory of finite-difference equations are used to derive a closed solution of an infinite system of algebraic equations, which makes it possible to present the dispersion formula in the form of a fourth-order determinant. The condition for a nontrivial solution of the system is formulated. References 4: 2 Russian, 1 Ukrainian, 1 Western.

USSR UDC: 621.315.592

CLASSICAL THEORY OF CYCLOTRON RESONANCE IN MANY-VALLEY SEMICONDUCTORS IN STRONG ELECTRIC FIELDS

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 13, No 4, Apr 79 pp 670-678 manuscript received 21 Jul 78

CHUYENKOV, V. A., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Abstract] A classical theory of cyclotron resonance for many-valley semiconductors is constructed on the basis of a kinetic equation with consideration of heating of the electron gas by a DC or AC electric field, and with regard to anisotropy of electron and phonon spectra and scattering probabilities. A detailed investigation is made of the shape of cyclotron resonance lines in n-type germanium in the case where the magnetic field is parallel to $\langle 110 \rangle$, the laternating electric field in parallel to $\langle 001 \rangle$, and the DC electric field is zero; lattice temperature was 30 K. With the fields oriented in this manner, the conduction band of germanium contains two groups of valleys distinguished by the conditions of heating of the electron gas. It is shown that in pure n-germanium (donor concentration of the order of 10^{12} cm^{-3} or less) as the alternating electric field strength increases there is an abrupt redistribution of electrons between valleys, leading to broadening of cyclotron resonance lines and a sharp reduction in the coefficient of absorption in the vicinity of resonance

points by as much as two orders of magnitude. In a very strong alternating electric field the redistribution of electrons between valleys is so pronounced that the absorption coefficient in the vicinity of resonance points shows anomalous behavior: when the magnetic field deviates from the resonance points there is an increase in the coefficient of absorption rather than the usual decline. At a given intensity of the heating AC electric field, the resonance lines become narrower with increasing donor concentration from about 10^{12} to about 10^{14} cm^{-3}, and there is an increase in the coefficient of absorption near resonance points. If the fields are oriented as before, and a strong DC heating field is applied parallel to a weak alternating electric field, an increase in the heating field causes broadening of the resonance lines and a sharp reduction in the coefficient of absorption in the vicinity of resonance lines. It is concluded that two conditions are necessary for observing these singularities of cyclotron frequencies and conditions of heating of the electron gas in the different vallyes; 2. pronounced redistribtion of electrons between valleys brought about by intervalley scattering of electrons by phonons at low temperatures and fairly low concentrations of impurity atoms. Figures 3; references 8: 5 Russian, 3 Western.

USSR UDC: 621.382.1

STUDY OF ELECTROPHYSICAL PARAMETERS OF HIGH-VOLTAGE/p-n JUNCTIONS BY THE METHOD OF LIGHT SCANNING

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 13, No 4, Apr 79 pp 701-706 manuscript received 9 Aug 78

VOLLE, V. M., VORONKOV, V. B., GREKHOV, I. V. and KOROBKOV, N. N., Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR, Leningrad

[Abstract] A method based on laser-beam deflection is used for optical scanning of diffused silicon p-n junctions to study inhomogeneities in the space-charge region and fluctuations of resistivity and minority carrier lifetime in the base region. The proposed technique gives a three-dimensional image of the photoresponse on a CRT display with resolution of 30 μm. It is shown by experiments and calculations that fluctuations in resistivity and lifetime can be distinguished by qualitative difference in the inverse voltage dependence of photoresponse. Large-scale periodic fluctuations of photocurrent in the form of "strata" 1 mm wide were observed in high-resistance silicon by using simultaneous brightness modulation and deflection of the CRT beam. A study of photomultiplication in the microplasma region showed that the voltage dependence of photocurrent when the multiplication process is initiated by holes is different from the dependence with initiation by electrons. The sharper rise of photocurrent with voltage before activation of the microplasma in the former case can be

attributed to sharper field dependence of the ionization coefficient. To explain the considerably sharper drop in photocurrent after activation of the microplasma, it is suggested that the ionization coefficient for holes depends much more strongly on temperature than is the case for electrons. Figures 5; references 5: 3 Russian, 2 Western.

USSR UDC: 621.315.592

SEMICONDUCTOR THERMOMETRY IN THE REGION OF LOW AND EXTREMELY LOW TEMPERATURES

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 13, No 4, Apr 79 pp 741-745 manuscript received 17 Oct 78

VOROBKALO, F. M., ZABRODSKIY, A. G., ZARUBIN, L. I., NEMISH, I. YU. and SHLIMAK, I. S., Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR, Leningrad

[Abstract] An investigation is made of the outlook for using semiconductor materials as sensors in cryogenic thermometers in the region of low and extremely low (less than 1 K) temperatures. It is shown that the Mott transition with respect to localized states in the vicinity of the Fermi level can be used as a physical basis in making wide-band semiconductor thermistors for low and extremely low temperatures. However, due to the strong concentration dependence of the Mott transition, its use imposes strict requirements on doping homogeneity that cannot be met by the conventional methods of doping. This problem is solved by neutron doping of germanium. Related thermometric and technological problems are discussed. Experimental thermometers based on the proposed principle show good sensitivity down to 0.03-0.05 K. This range could be extended even lower by improving heat exchange conditions to keep the power dissipation below 10^{-9} T^3 (W/K^3). The authors thank K. N. Zinov'yeva and A. A. Golub' for graduating the thermometers. Figures 2; references 18: 12 Russian, 6 Western.

USSR UDC: 621.315.592

MACROSCOPIC RECOMBINATION CENTERS AND THEIR USE FOR CHANGING THE INTENSITY OF GENERATION-RECOMBINATION PROCESSES ON THE SURFACE OF A SEMICONDUCTOR

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 13, No 4, Apr 79 pp 780-786 manuscript received 14 Mar 78, after revision 5 Dec 78

RYVKIN, S. M., Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR, Leningrad

[Abstract] The author discusses the limitations of the technique of creating high local concentrations of impurities and point defects to act as recombination centers in semiconductors for intensifying generation-recombination processes. An alternative method is considered in which macroscopic "traps" for electrons and holes are used for this purpose. It is shown that such macroscopic recombination centers can be produced by creating short-circuited n^+ and P^+ regions on the semiconductor surface. An analysis is made of the possibility of regulating the surface recombination rate when such centers are present. The influence that these centers have on processes of exclusion and accumulation is considered as an example. The author thanks D. V. Tarkhin for constructive criticism, and D. G. Ryvkina for assistance with some calculations. Figures 5; references 4: Russian.

USSR UDC: 621.315.592

NEGATIVE PHOTOCONDUCTIVITY IN HIGHLY COMPENSATED SPECIMENS OF n-GaAs AT LOW TEMPERATURES

Leningrad FIZIKA I TEKHNKA POLUPROVODNIKOV in Russian Vol 13, No 4, Aor 79 pp 805-808 manuscript received 13 Jun 78, after revision 11 Oct 78

KANSKAYA, L. M. and KOLCHANOVA, N. M., Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR, Leningrad

[Abstract] The authors discuss possible mechanisms that may be responsible for negative photoconductivity over a broad spectral range at temperatures of 4.2-77 K. The spectral distribution of photoconductivity was studied in GaAs<Ni> crystals with equilibrium carrier concentration of about 10^{13} cm^{-3} at the liquid nitrogen temperature. The crystals were heavily compensated semiconductors (K=0.95) with low carrier mobility. A characteristic feature of the spectra was negative photoconductivity when the energy of the incident quantum was less than the sidth of the forbidden band. In the energy region of 1.46-1.49 eV, the negative photoconductivity observed at 77 K becomes positive with falling temperature. Long-wave

photoconductivity ($h\nu < 1.43$ eV) even increases slighly in absolute magnitude rather than falling off as the temperature is reduced to 4.2 K. Observation of negative photoconductivity throughout the given temperature interval indicates that when GaAs crystals are doped with impurities that produce deep levels, there is a concomitant effect of broad regions of inclusions caused by nonhomogeneous distribution of the injected atoms. Negative photoconductivity in compensated crystals cannot be attributed to a single mechanism, as the nature of the effect may differ even under the same physical conditions. Figures 3; references 6: 5 Russian, 1 Western.

USSR

STRUCTURAL PHASE TRANSITION IN NONCENTROSYMMETRICAL AND CENTROSYMMETRICAL MEDIA AS INDUCED BY LASER RADIATION

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21 No 3, May 79 pp 688-695
manuscript received 14 Aug 78

EMEL'YANOV, V. I. and INDENBOM, M. V., Moscow State University imeni M. V. Lomonosov

[Abstract] The effect of laser radiation on structural phase transitions in crystals usually reduces to effectively reducing the Curie point T_c. In this connection, it was of interest to determine the conditions in which laser radiation would induce a phase transition (for substances with a temperature-dependent phase transition this would signify an effective increase in T_c). It is demonstrated that in certain conditions laser radiation induces a ferroelectric (in the general case, structural) phase transition in media consisting of either noncentrosymmetrical (two-level) or centrosymmetrical (three-level) systems interacting via the Lorentz field of via optical phonons. When the pumping rate exceeds the critical limit, an order parameter macroscopic static polarization or static lattice displacement) increasing with increase in pumping rate spontaneously arises in the medium. Induces phase transitions of this kind prove to be mathematically (in structure of equations) analogous to the order-disorder phase transition investigated by G. Bostel et al. (PHYS. STAT. SOL.(b), 70, 641, 1975), so far as noncentrosymmetrical systems are concerned. These findings may prove useful in interpreting spectroscopic data on the appearance and disappearance of new absorption lines upon illumination of matter by laser radiation, and on displacement of levels. If the laser field is generated by the medium itself, a self-induced phase transition of the above type may occur in the medium, which may affect the dynamics of solid-state lasers. Figures 2; references 13: 12 Russian, 1 Western.

USSR

ELECTRON-HOLE FLUID IN STRONGLY ANISOTROPIC POLAR SEMICONDUCTORS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21 No 3, May 78, pp 839-842

ANDRYUSHIN, YE. A. and SILIN. A. P., Moscow, Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] Polar semiconductors with a marked anisotropy of their electron spectrum are considered as a model for examining the interaction between the electron-hole system and phonons. The bonding energy and density of the resultant electron-hole fluid are calculated. Electron-phonon interaction then provides the principal contribution to the system's energy. The derived formulas are used to estimate the energy and density of the fundamental state of electron-hole fluid in chalcogenides of lead and tin and in thallium halides with the experimental findings proving to be in agreement with the theory. This demonstrates the suitability of determining the electron-hole fluid in strongly anisotropic polar semiconductors. Chalcogenides of zinc and cadmium also are promising from this standpoint, as are various modifications of silicon carbide. However, their band structure is not known with sufficient accuracy, and this complicates the calculations. References 12: 7 Russian, 5 Western.

USSR

STUDY OF CRYSTALS OF SOLID SOLUTIONS OF GERMANIUM-SILICON-ANTIMONY GROWN IN THE "UNIVERSAL FURNACE" EXPERIMENT OF THE APOLLO-SOYUZ PROGRAM

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21 No 4, Apr 79 pp 987-1000
manuscript received 29 Jul 77; after revision 18 Sep 78

ZEMSKOV, V. S., SHUL'PINA, I. L., TITKOV, A. N., BELOKUROVA, I. N., GUSEVA, N. B. and SAFAROV, V. I., Physico-Technical Institute imeni A. F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] An experiment to produce solid semiconductor solutions by normal directed crystallization was conducted during the Soviet-American joint orbital flight of Apollo-Soyuz. It was aimed at studying the process of melting and crystallization of solid solutions under conditions of minimal gravitation and theprocesses of mass transfer in molten solutions. On Earth, gravity affects convective mixing of molten solutions and has a strong influence on crystal growth. Cylindrical slabs were prepared by pulling from a melt continuously impregnated with silicon. Slabs contained 0.7 or 1.0 atom. percent silicon, 0.001 at. % antimony with an average density of dislocations of 10^3 cm^{-2}. Slabs were sealed in quartz vials

evacuated to a pressure of 10^{-4} torr, with no more than 0.1 mm clearance between the slab and the vial wall. Ge-Si-Sb crystals grown in space have significant macro- and microirregularities and more imperfect structure than crystals grown on Earth under similar conditions. The significant irregularity of crystals in cross sections is explained on the basis of barometric diffusion arising because of the gradient of hydrostatic compression of the melt in fields of gravitation and inertia. Barometric diffusion and its effect on the flow of processes should be analyzed in all cases, whether physical, chemical or physico-chemical processes occurring in liquid or gaseous media under critical conditions of phase transitions. Figures 12; references 23: 17 Russian, 6 Western.

USSR

MEASUREMENT OF COEFFICIENTS OF HYDROGEN DIFFUSION IN METALS WITH LOW ADSORPTIVE ACTIVITY BY ESTABLISHING A STATIONARY FLOW

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21 No 4, Apr 79 pp 1060-1063
manuscript received 25 Jul 78; after revision 1 Nov 78

KURAKIN, V. A., KURDYUMOV, A. A., LYASNIKOV, V. N. and POTAPOV, M. I.,
Leningrad State University imeni A. A. Zhdanov

[Abstract] The method of establishing a stationary flow has been well developed in both theoretical and experimental practices and is widely used to measure the diffusion coefficients of hydrogen in metals. If the rate of all phase-boundary processes is sufficiently high, the diffusion removal of gas from near-surface layers does not affect the magnitude of its concentration in these layers. Experimental measurement of the process rate is complicated and labor-intensive. Theoretically, this problem can be avoided by greatly increasing gas pressure and specimen thickness. This approach is unacceptable in most cases because of the limited mechanical strength of specimens and sensitivity of methods. The proposed method can measure hydrogen diffusion coefficients by using thin specimens and by not determining the rate of adsorption even in temperature intervals where the process of penetration from the molecular phase is wholly defined by this rate. The use of hydrogen atomization in its gaseous phase permits substantial expansion of the temperature range of measurement of the diffusion coefficient in metals with low adsorptive activity by establishing stationary flow in the range of low temperatures. Figures 4; references 8: 7 Russian, 1 Western.

USSR

PHASE TRANSITION IN SOLID He^4

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21 No 4, Apr 79 pp 1130-1134
manuscript received 13 Jun 78; after revision 24 Nov 78

VARDANYAN, G. A., Yerevan State University

[Abstract] According to the theory of Andreyev and Lifshits, zero oscillations of atoms in solid helium^4 are not small in comparison to the permanent lattice; consequently they change into virtually freely moving quasi-particles in a discrete space of the crystal. The discreteness of the space governs the particular behavior of all typical values of a non-ideal lattice system. This is mainly connected with features of amplitude of scattering of quasi-particles on each other. An interesting aspect of the scattering process is that several scattered waves can be simultaneously propagated in certain directions in the crystal, while a single wave may be propagated in other directions. This affect and all lattice properties are also essential to describe the thermodynamic state of the system of helium^4 atoms. But the thermodynamic characteristics of crystalline helium^4 in the range of temperatures and pressures considered can also be derived by approximating the closest neighbors in the lattice. This concerns the typical values in phase transition of crystalline helium^4 to the state of a quantum crystal. It is assumed that in this state, atoms can tunnel into the nearest and second nearest lattice sites. It is shown that as solid helium^4 changes to the quantum crystal state, the frequency of sound at which efficient absorption is possible is reduced, because efficient absorption generally occurs when $\omega\tau$ is about unity. References 7; 6 Russian, 1 Western.

USSR

TWO-PHOTON SPECTROSCOPY STUDY OF THE BAND STRUCTURE OF $SrTiO_3$

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21 No 4, Apr 79 pp 1140-1146
manuscript received 11 Oct 78; after revision 27 Nov 78

SHABLAYEV, S. I., DANISHEVSKIY, A. M., SUBASHIYEV, V. K. and BABASHKIN, A. A., Physico-Technical Institute imeni A. F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] The structure of energy bands of strontium titanate has attracted investigators for several years. Calculations of the band structure of $SrTiO_3$ mainly yielded a similar picture of band arrangement, but the accuracy of computations does not permit us to determine the position of extrema corresponding to the minimum energy gap between the

balence band and the conduction band. An experiment was run using three specimens of strontium titanate, 9-15 mm long. Specimens #2 and #3 were transparent and colorless, while #1 was lightly colored. In experiments in two-photon spectroscopy counter-directed beams of light from a neodymium laser and an ISSh-400 flash tube were used. The crystal was placed between permitting matching of both beams on the specimen. A probing light pulse 1.5 microseconds in length was modulated when it passed through the crystal by laser emission (pulse length 17 ns) and was directed into a monochromator and then into photomultiplier. The electrical pulse from the photomultiplier was strobed (strobe length 4 ns) at two points on the flat top of the pulse 30 ns apart so that values of the flux of the probing emission were established without exposing the crystal to pumping emission. The results of two-photon measurements confirm earlier conclusions about the indirect nature of optical transitions on the absorption edge of strontium titanate. In the range of energies of 4.1 eV and higher, the behavior of the two-photon spectrum agrees in quality with features of the ε_2 spectrum and the results of theoretical solutions. A clearly expressed step structure shows up in the two-photon spectrum at a comparatively high temperature (300°K), whereas in one-photon spectra this structure is not observed. One-photon spectra obtained for $SrTiO_3$ and other similar materials at room temperature generally have a long "Urbach tail", complicating determination of E_g. The virtual lack of any analog in the two-photon spectrum suggests that the method of two-photon spectroscopy will be able to more accurately determine the value of E_g and identify the nature of edge transitions of other materials. Figures 5; Tables 1; references 20: 1 Russian, 19 Western.

USSR

MICROWAVE TUNNEL ECHO IN GLASS

Moscow PIM'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 29 No 8, 20 Apr 79 pp 464-467 manuscript received 1 Mar 79

SMOLYAKOV, B. P. and KHAYMOVICH, YE. P., Kazan Physico-Technical Institute, USSR Academy of Sciences

[Abstract] The use of various physical methods in glass at low temperatures has revealed abnormal behavior of thermal capacity and sound absorption, dependence of damping of sound pulses on their intensity, phonon echo, etc. These phenomena are due to the presence of a spectrum of elementary excitations in amorphous media caused by a tunnel transition. A microwave echo was observed for the first time in glass which is independent of the constant magnetic field; this suggests that this effect is most likely caused by low-energy excitations and may be called a microwave tunnel echo. Experiments were conducted in a range of temperatures from 4.2 to 1.8 K at a

frequency of 9.5 GHz. Glass specimens were placed in the maximum electrical microwave field at a cavity resonator. Damping of coupled waves differs from pure pseudospin oscillations; this apparently results in the various relaxation times detected where $H = 0$ and $H \neq 0$. The study of tunnel transitions in glass using microwave echo is much simpler than acoustic echo and will be widely used in the study of amorphous bodies. Figures 2; references 6: 1 Russian, 5 Western.

USSR

MICROWAVE BREAKDOWN IN GERMANIUM IN A CONSTANT MAGNETIC FIELD

Moscow PIM'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 29 No 8, 20 Apr 79 pp 471-474 manuscript received 15 Mar 79

MANENKOV, A. A., MILYAYEV, V. A. and SANINA, B. V., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] Study of the effect of pulsed microwave breakdown of an exciton gas in the presence of electron-hole droplets permitted analysis of certain important characteristics of the system: free carriers--exciton--acrrier concentration in droplets, droplet radius and lifetime. A constant external magnetic field affects the nature of breakdown of excitons in a continuous microwave field; but detailed research and interpretation of this effect had not been carried out. In a pulsed microwave field one could anticipate that the presence of an external magnetic field would show up in the properties of exciton breakdown. The breakdown threshold should change, especially near lines of cyclotron resonance; and time characteristics of breakdown associated with droplet capture of free carriers. Pulsed microwave breakdown of exciton gas in germanium was studied at $T = 1.3$ K in the presence of a constant magnetic field. The external magnetic field also affects the shape of the breakdown spike which describes the process of evolution of avalanche ionization of excitons and droplet capture of carriers. The leading and trailing edges of the conductivity signal spike of the specimen become noticeably longer during breakdown. This is apparently linked with the reduced rate of impact ionization and droplet caputure of carriers as a result of cyclotron warping of free carrier trajectories in the magnetic field. Figures 2; references 3: Russian.

USSR UDC: 517.9

AXISYMMETRIC RADIATION OF ACOUSTIC WAVES BY A LOCALLY PERTURBED HALF-SPACE IMPEDANCE BOUNDARY

Kiev DOPOVIDI AKADEMIYI NAUK UKRAIYANS'KOYI RSR, Seriya A, FIZYKO-MATEMATYCHNI TA TEKHNICHNI NAUKY in Ukrainian No 4, 1979 pp 267-270
manuscript received 10 Jul 78

HALAZYUK, V. A. and KHILO, O. YE., L'vov State University

[Abstract] Fundamental solutions of the combined problem of hydroacoustics are derived for a half-space with an impedance boundary when that boundary is perturbed by an acoustic wave incident at right angles over a circle and periphery of arbitrary radius, with the perturbation starting at the coordinate origin. This includes the formulation of the boundary-value problem for the pressure of the incident wave and the solution of the problem for the radiation of acoustic waves by the impedance boundary of an half-space perturbed over the circle $0 \leq \alpha \leq \alpha_0$, as well as for cases in which $\sigma = 0$ and $\sigma = \infty$, where σ is the wave pressure. References 2: Russian.

USSR

INTERACTION OF STRINGS IN QUANTUM CHROMODYNAMICS

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 29 No 8, Apr 79 pp 506-510 manuscript received 20 Feb 79

BORISOV, N. V., IOFFEE, M. V. and EYDES, M. I., Leningrad State University imeni A. A. Zhdanov

[Abstract] In the frameowrk of quantum chromodynamics the structure of interaction of hardrons described by strings with quarks on their ends has been established. Interaction constants are set by the quantities. $\sqrt{a_s}/m_k$, whose values have been defined by Shifman et al. The theory of strong interactions with color gage group $SU(3)_c$ is examined. In this theory, it is possible to construct gage-invariant operators which correspond to a closed loop C (pomeron), open loop C_{xy} with quarks at its ends x,y (meson) and baryon configuration C_{xyz} with quarks at points x,y,z. These gage-invariant operators approximately describe the hadrons in quantum chromodynamics. Quark motion at the end of strongs is considered. The force of interaction of various strings is defined by the "flavor" of nascent (or annihilating) quarks and is inversely proportional to their mass. Within the framework of quantum chromodynamcs, an effective string Lagrangian is constructed in which all hadron interaction constants are known. Figures 1; references 11: 5 Russian, 6 Western.

USSR

WEAK INTERACTION OF NUCLEONS AND THE PROCESS $n + p \to d + \gamma$

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 29 No 8, 20 Apr 79 pp 517-520 manuscript received 14 Mar 79

LOBOV, G. A., Institute of Theoretical and Experimental Physics

[Abstract] Discovery of the weak interaction of nucleons led to the intensive study of various effects of its aypearance. The Weinberg-Salam model is used to construct potentials of nucleon weak interactions and the effects of this interaction in the process $n + p \to d +$ are considered: circular polarization of the photon in capture of an unpolarized thermal neutron and asymmetry of photon ejection in capture of a polarized neutron. The effective Hamiltonian of weak interaction is presented in the form of a symmetrized product of current where $G = 10^{-5}M^{-2}$ is the constant of weak interaction. Potentials of rho and omega exchange contribute to circular polarization of photons in the $n + p \to d + \gamma$ process. The experimental value of $A_\gamma = (0.6 \pm 2.1) \times 10^{-7}$ has insufficient accuracy for a detailed comparison with theoretical results. References 14: 2 Russian, 12 Western.

USSR

MUST WE TAKE INTO ACCOUNT THE CONTRIBUTION OF MANY-PHOTON EXCHANGES TO STRONGLY INELASTIC ELECTRON-PROTON SCATTERING?

Moscow TEORETICHESKAYA I MATEMATICHESKAYA FIZIKA in Russian Vol 39 No 1, Apr 79 pp 48-63 manuscript received 17 Feb 78

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[Abstract] A qualitatively new property of interaction of elementary particles at high energies is multiple production of hadrons. Observation of this process shows the hadrons are complex objects. A new physical characteristic--the inclusive cross section--aided progress in solving this problem: it contains sufficiently complete information on the mechanism of formation of secondary particles and at the same time yields to theoretical and experimental analysis. Inclusive electron-proton scattering is the most convenient means of studying the internal structure of hadrons. Thorough analysis of experimental data showed that structural functions, even with fixed omega, greatly depend on Q^2; this led to the search for another scalar variable which would not lead to disturbance of scalar invariance. Intensification of multiple exchanges may be linked with properties of processes of multiple production of hadrons in the strongly inelastic region. The inclusive cross section must be computed in all orders in terms of the electromagnetic bonding constant. Figures 1; references 19: 2 Russian, 17 Western.

USSR

NEUTRINO FORM-FACTORS IN THE TWO-DIMENSIONAL APPROXIMATION OF QUANTUM ELECTRODYNAMICS

Moscow TEORETICHESKAYA I MATEMATICHESKAYA FIZIKA in Russian Vol 39 No 1, Apr 79 pp 64-69 manuscript received 20 Apr 78

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[Abstract] Because of the possible existence of magnetic fields on the order (or higher) of the typical magnitude $B_0 = m^2/e = 4.41 \times 10^{13}$ Gs, it becomes important to know the limits of applicability of the theory of perturbations and the parameter of decomposition in quantum electrodynamics with an external force field. It may be solved in particular by direct computation of corrections of a higher order in terms of alpha for initial expressions. This was first done by Jankovici; we developed a standardized method of computation of Feynman diagrams in an intense magnetic field, a two-dimensional approximation of quantum electrodynamics. Form-factor A of gamma decay to $\nu\bar{\nu}$ does not depend on the field in the lowest approximation

in terms of alpha; at the same time, the radiation correction which corresponds to the contribution of the "mass" diagram increases as the square of the logarithm in proportion to B. The radiation correction for "contact" peaks also rises with the field, but only logarithmically: the constraint on the magnitude of the field is somewhat less rigid. This is because the contribution of terms proportional to $\sigma_{\mu\nu}K^{\nu}$ and $\tilde{\gamma}^{5}K_{\mu}$ which are logarithmically dependent on the field, is suppressed in the low-energy approximation. Figures 2; references 12: 7 Russian, 5 Western.

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LASER SPECTROSCOPY OF RAMAN SCATTERING IN NONLINEAR CRYSTALS

Dushanbe IZVESTIYA AKADEMII ANUK TADZHIKSKOY SSR in Russian No 4(70), Oct-Dec 1978 pp 3-17 manuscript received 17 Jul 78

ADKHAMOV, A. A., GORELIK, V. S. and UMAROV, B. S., Physico-Technical Institute imeni S. U. Umarov, Tadzhik SSR Academy of Sciences, Dushanbe and Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences, Moscow

[Abstract] Nonlinear crystals represent a large number of crystalline structures characterized by the lack of an inversion center in the symmetry group of point transformations. Research into these crystals has recently increased in importance in connection with the need for an effective control of the parameters of the generation of laser radiation (frequency, polarization, duration). This paper deals with the theory of Raman scattering (RS) in nonlinear crystals-in general as well as with RS in diatomic and polyatomic nonlinear cubic crystals. RS spectra in anisotropic (mono- and biaxial crystals also are considered. These crystals are characterized by the absence of distinct "soft" vibrations, presence of a strong interaction between normal vibrations resulting in continualization of the vibrational spectrum, and presence of resonance redistributions of spectral intensity in the neighborhood of the phase transition point. Further basic and applied research is expected to yield information on various kinds of parameters of the known nonlinear crystals and promote the discovery of new promising materials. Figures 12; references 19: 15 Russian, 4 Western.

USSR

ON THE CONNECTION BETWEEN SOFTENING POINT AND ERASURE POINT OF OPTICAL MEMORY IN CHALCOGENIDE VITREOUS SEMICONDUCTORS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21 No 4, Apr 79 pp 1020-1024
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KOLOMIYETS, B. T., LANTRATOVA, S. S., LYUBIN, V. M. and SHILO, V. P., Physico-Technical Institute imeni A. F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] Reversible photo-stimulated changes in optical properties of chalcogenide vitreous semiconductors have lately attracted much research interest because changes in their optical properties are accompanied by changes in certain physico-chemical parameters, such as solubility in various solvents, microhardness and density. Many investigators have indicated that restroation of initial values optical parameters (or erasure of optical memory) can be accomplished by heating these materials to temperatures near the softening point. The initial semiconductors were synthesized by the standard method of vacuum sputtering. Film composition was monitored by methods of X-ray spectral and microchemical analysis: accuracy was found to be 10%. Analysis of softening points of non-irradiated and irradiated segments of film and total erasure point was first done using As_3Se_2, which has greatest light sensitivity. Difference in softening points of irradiated and non-irradiated film sections of As_3Se_2 together with data on the corresponding difference in microhardness, thickness, solubility and rate of propagation of ultrasound prove that the entire system of physico-chemical parameters of the films is reversibly altered during irradiation and erasure. The specific role of As-As bonds in photostructural transformations of chalcogenide vitreous semiconductors can be understood in terms of the following notions: in stoichiometric, the ceiling of the valence band is to a great extent determined by unshared electron pairs of the chalcogen. When these electrons come under the effect of light, it does not weaken interatomic bonds and thus does not induce structural changes. An increase or reduction in excess arsenic gives rise to states determined by arsenic electrons in the balence band. When these electrons are irradiated, interatomic bonds are weakened (especially As-As bonds) and new metastable structures are formed, accompanied by substantive changes in optical and physico-chemical properties. Figures 4; Tables 1; references 20: 8 Russian, 12 Western.

USSR

EFFECT OF DIE'ECTRIZATION OF ELECTRONS ON MAGNETIC PROPERTIES OF SUPERCONDUCTORS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21 No 4, Apr 79 pp 1195-1204 manuscript received 8 Dec 78

KOPAYEV, YU. V. and MOLOTKOV, S. N., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences, Moscow

[Abstract] Interest has recently grown in substances whose superconductive transition is preceded by a structural transition. These compounds are the highest-temperature superconductors. Dielectric re-alignment of the system can lead to increased density of states on the edges of the dielectric gap. Ginzburg-Landau equations were derived from microscopic theory for a system with simultaneous Cooper and dielectric pairing. Two limiting cases were examined. In the first case, where the structural transition point is much higher than the superconductivity temperature, ordinary Ginzburg-Landau equations were derived for the superconductive order parameter. But the dielectrization of the system leads to renormalization of coefficients in the equation and to a net reduction in the magnitude of superconductive current. In the other limiting case, where $T_c \simeq T_D$, a system of three coupled equations was derived for the field, S and D (The order parameters). The critical value of the Ginzberg-Landau parameters in the scheme with one superconductive order parameter is equal to $1/\sqrt{2}$. A situation where the Ginzberg-Landau parameter is greater is possible, but the system remains a type I superconductor since the critical value with these parameters is greater than $1/\sqrt{2}$. References 12: 9 Russian, 3 Western.

USSR

SUPERCONDUCTIVITY OF SODIUM CHLORIDE AT HIGH PRESSURE

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 29 No 8, 20 Apr 79 pp 460-463 manuscript received 7 Mar 79

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[Abstract] Sodium chloride has been intensively investigated in high pressure physics, especially as a substance by which pressure can be determined. Under pressure, sodium chloride becomes a denser modification with the structure of CsCl and is a dielectric. Metallization of NaCl has often been discussed; at pressure of about 1.35 mbar the metallic state is more stable. A small screw press and high pressure chamber were

used to detect the superconductivity of sodium chloride's conductive modification. External magnetic fields also reduce change in specimen resistance. The conductive modification of sodium chloride is superconductive at temperatures below 7 K. The critical magnetic field is more than $2X10^6$ A/m. Figures 3; references 10: 7 Russian, 10 Western.

USSR

COEXISTENCE OF DIELECTRIC AND SUPERCONDUCTIVE ORDERING IN TWO-BAND SYSTEMS

Moscow TEORETICHESKAYA I MATEMATICHESKAYA FIZIKA in Russian Vol 39 No 1, Apr 79 pp 118-129 manuscript received 28 May 78

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[Abstract] The search for superconductors with high critical temperatures has been going for the last few years. It has been desired to obtain high temperature superconductors with quasi-one-dimensional type systems. In such systems, Peierls instability, Coulomb interaction of electrons and lattice disorder lead to the basic dielectric state of the system. In crystals in which the effect Coulomb interaction of electrons is weak and electron-phonon interaction is intense, the basic state of the electron system is determined by competition of Peierls and superconductive instabilities. Interest was raised in the possible suppression of Peierls instability or its coexistence with superconductive instability. The question about the existence of dielectric and superconductive phases in two-band metals and compounds where one band is two-dimensional was of great interest. In that system, partial dielectrization of conductivion electrons is possible. The behavior of a two-band system with deviation from half filling of a one-dimensional band was studied. There is also interest in the possible production of a dielectric state against a background of a superconductive state. Superconductivity was found to block the dielectric transition. References 11: 6 Russian, 5 Western.

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